

% Lesson Address	6.2.xxx
% Lesson Title	Spreadsheet Exploration
% Lesson Narrative	Students begin to learn how spreadsheets work by exploring "Guess My Rule" questions in a ready-made spreadsheet
% Learning Goals	<ul style="list-style-type: none"> • Learn how a spreadsheet does calculations. • Adapt an existing spreadsheet to change its functions
% Required Materials	<ul style="list-style-type: none"> • Devices with spreadsheets, ideally one per student • Recommended: teacher's computer with projector, server for distributing and collecting work • For alternative paper and pencil version, printed worksheets

% Classroom Activity Title	Mystery Spreadsheet
% Classroom Activity Type	Digital classroom activity
%Time Estimate in Minutes	25 minutes if students know how to quickly and efficiently get out their devices and start working. If not, it may take 45 minutes, and will need to include instruction on classroom protocols for using technology.
% Classroom Activity Narrative	Spreadsheets are a major use of algebra in the real world, specifically writing and analyzing formulas. This lesson introduces students to how spreadsheets do computations, and how a spreadsheet will automatically change the result if the inputs to a calculation are changed.
% Activity Setup	<p>Seat students in pairs, preferably each with their own device. If necessary, two students can take turns sharing a device.</p> <p>Each device should have a copy of MysterySpreadsheet.xlsx that students can change and save.</p> <p>Instructions</p>
% Classroom Activity Launch	<p>Spreadsheets are a type of software used in many places, especially business. Has anyone ever used a spreadsheet, or do you know someone who does?</p> <p>We will be using a premade spreadsheet file that has Guess My Rule questions built into it.</p> <p>Have you played Guess My Rule before? Who can summarize how it works?</p> <p>In this version, there are four cells: A2, A3, A4, and A5 that contain numbers that you can change. There are four rules in B2, B3, B4, B5 that use some or all of the four A cells. Your job is to figure out what each rule is by changing the numbers in the As and seeing what happens in the Bs. Do one rule at a time; start with B2.</p>

	<p>Start by thinking on your own. After you have tried for 5 minutes, you may talk to your partner.</p> <p>If you and your partner figure out all four rules, raise your hand, and then make your own rule in the spreadsheet file to have your partner figure out.</p> <p>Now please open your devices, open the file MysterySpreadsheet.xls, and start.</p>
% Classroom Activity Task Statement --- Digital	Included in spreadsheet file
%Classroom Activity Task Statement --- Print	If teacher has a computer and projector, do a teacher-led version of the activity. Students suggest numbers to try in the A cells, teacher types them in, pairs discuss the possible rules.
% Classroom Activity Discussion	<p>Some students may realize (right away!) that the rule is described in the cell where the output is. If you click/tap in that cell, the formula appears in the formula/typing bar, usually at the top of the window. For computers and some other devices, double-clicking allows you to view the formula in the cell (and type to change it, if desired).</p> <p>Once a few students have realized this, ask them to tell the groups near them, until it spreads through the classroom.</p> <p>What the rules were:</p> <p style="padding-left: 40px;">B2=A3+A4</p> <p style="padding-left: 40px;">B3=</p> <p style="padding-left: 40px;">B4=SUM(A2:A5)</p> <p style="padding-left: 40px;">B5=PRODUCT(A2:A5)</p> <p>Discuss how to translate the code in the cell (yes, this is a form of coding!):</p> <p style="padding-left: 40px;">starting with = tells the program to do a computation</p> <p style="padding-left: 40px;">A letter-number combination is an address of a cell where to find a number</p> <p style="padding-left: 40px;">* means multiply (not x or .)</p> <p style="padding-left: 40px;">Sum is the result of addition. In this case, the colon : means "through": add the numbers in cells A2 through A5</p> <p style="padding-left: 40px;">Product is the result of multiplication; similar to previous</p> <p>Ask students (preferably ones you know did something interesting but not too complicated) for their rules they made up</p> <p>Or: Have the class suggest a rule, and correctly enter it into the spreadsheet</p>

% Lesson Address	6.2.yyy
% Lesson Title	Problem solving with formulas in spreadsheets
% Lesson Narrative	Students continue to inspect spreadsheets and read formulas, then they write their own formulas involving the four arithmetic operations to solve arithmetic problems. They learn to organize their work with labels and formulas.
% Learning Goals	<ul style="list-style-type: none"> • Read and decipher formulas in spreadsheet files • Use formulas in spreadsheets to solve arithmetic word problems • Use estimation to partially check work • Organize work in a table with labels
% Required Materials	<ul style="list-style-type: none"> • Devices with spreadsheets, preferably one per student • Blank spreadsheet activity file SpreadsheetLesson2.xlsx for each student

% Classroom Activity Title	Telling a Spreadsheet What to Do, part I
% Classroom Activity Type	Digital Classroom Activity
%Time Estimate in Minutes	10 minutes
% Classroom Activity Narrative	<p>Part I asks students to write their own formulas for simple arithmetic problems. The numbers are purposely "unfriendly" to emphasize that they should delegate the actual calculation to the spreadsheet.</p> <p>It's important to reinforce the habit of checking by estimating. This applies to any kind of math problem, not just spreadsheets.</p>
% Activity Setup	Students get ready to use their devices: turn them on and download the spreadsheet SpreadsheetLesson2. Close device while listening to instructions.
% Classroom Activity Launch	<p>When you are in charge of getting a job done, like planning a class party, usually you don't do it all yourself. You <i>*delegate*</i> parts of the job to other people; that is, you tell other people (politely) to do things. This is the strategy with spreadsheets: get the spreadsheet to do as much as possible, so that you don't have to do it yourself.</p> <p>In SpreadsheetLesson1, you saw that you can type formulas that the spreadsheet will calculate. Each formula must start with an = sign.</p> <p>Here are the keys for the four arithmetic operations:</p> <p>Addition: +. You will need to use the shift key on a computer.</p> <p>Subtraction: - (same as hyphen). Do NOT use the shift key on a computer.</p> <p>Multiplication: *. This is shift 8 on a computer.</p>

	<p>Division: /. This is under the question mark on a computer; don't use shift.</p> <p>If you are using a tablet or phone, you will have to call up other virtual keyboards to find these symbols.</p> <p>An important part of working with a spreadsheet is checking your work, since sometimes you type something wrong. You can do a partial check by estimating. For example, if you are trying to add 28370 and 8762, and you get 11599, does this seem to be correct?</p> <p>No, because 28370 is already more than 11599. Since 28370 is close to 30,000 and 8762 is close to 10,000, the answer should be around 40,000. Maybe you typed in a number incorrectly.</p> <p>In fact, the formula says =2837+8762; somehow the 0 at the end got left off.</p>
% Classroom Activity Task Statement --- Digital	Do the four arithmetic problems in rows 9 through 12. Do NOT retype the numbers. Check your answer by estimating.
% Classroom Activity Discussion	<p>What answers did you get?</p> <p>If there is disagreement, ask for estimates to determine which is more likely to be correct; then fix the formula.</p>

% Student Response Long Narrative Digital	<p>See SpreadsheetLesson2-Answers.xlsx</p> <p>cell E9: =B9+D9, 100046.815</p> <p>cell E10: =D10-B10, 33.7106</p> <p>Note that the order of subtraction second number - first number. Students who did first - second will get the correct size of answer, but with a - sign in front, or perhaps in red (which indicates a negative number). Negative numbers are addressed in a later unit in Grade 6.</p> <p>cell E11: =B11*D11, 38568686.48</p> <p>cell E12: =B12/D12, 0.004504505 (rounded)</p> <p>Students might have divided in the opposite order, D12/B12, since that makes the quotient a whole number (incorrect). The exact quotient is a repeating decimal, so the answers may be displayed differently in different students' work. Spreadsheets often round answers to fit in the width of the cell, and will round differently if the width changes.</p>
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% Classroom Activity Title	What's Happening? (Telling a Spreadsheet What to Do, part II)
% Classroom Activity Type	Digital Classroom Activity
%Time Estimate in Minutes	10 minutes
% Classroom Activity Narrative	<p>A premade spreadsheet is provided that is a bill for purchases from a cheese store. Students analyze all the numbers, and find what calculations were done, and how. The point is for them to think carefully about how to set up a spreadsheet, using the built-in row and column structure, and notice how the labels/headings help understand what</p>

	the spreadsheet is doing.
% Activity Setup	Devices and spreadsheet from Part I.
% Classroom Activity Task Statement --- Digital	Look farther down in your spreadsheet and find a bill for a bunch of cheese purchased at a cheese store. Figure out what all the numbers mean, and figure out how all the calculations were done.
% Classroom Activity Discussion	<p>Which numbers were typed in, and which numbers were calculated by the spreadsheet?</p> <p>Pick a number in the D column and ask how it was calculated.</p> <p>How was the total calculated?</p> <p>Do the numbers and calculations look reasonable?</p>

% Student Response Long Narrative Digital	<p>The type of cheese the customer bought is in column A. For each type, the weight of that kind of cheese the customer bought is in column B.</p> <p>The price for one pound of that kind of cheese is listed to the right, in column C.</p> <p>The cost for that amount of cheese is in column D.</p> <p>The total the customer owes for all the cheese is in cell D24.</p> <p>The numbers in columns B and C all had to be typed in. The costs for types of cheese were calculated by the spreadsheet, by multiplying the number of pounds by the price per pound. For example, the cost for the cheddar cheese is $=B19*C19$.</p> <p>The total owed was calculated with the SUM formula, which adds all the total costs for types of cheese in one step: $=SUM(D19:D23)$</p> <p>These amounts of cheese look like a lot; maybe the person buying them runs a restaurant. A pound of cheese from the supermarket is about this big (show with hands). The calculations look reasonable. For example, there are more than 5 lb. of cheese, and it costs more than \$4 per pound, so the total for cheddar should be more than \$20. The numbers are all in the teens, twenties, and thirties, and look like they could add to about \$100.</p>
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% Classroom Activity Title	Show Your Work: Telling a Spreadsheet What to Do, part III
% Classroom Activity Type	Digital Classroom Activity
%Time Estimate in Minutes	20 minutes
% Classroom Activity Narrative	<p>Students solve word problems requiring +, -, *, / and set up their own spreadsheets to solve them.</p> <p>The point is that in a spreadsheet, "Show your work" means typing a formula, and labeling the inputs and outputs for the formula in a way that another person can understand what you did.</p>
% Activity Setup	Devices and spreadsheet file from parts I and II

% Classroom Activity Task Statement --- Digital

Solve problems 5-10 using formulas in the spreadsheet.
Organize your work so that another person can easily understand what you did. Include labels for all the numbers in each problem.

If you finish, see if your partner needs help, or compare your work. Then choose an extension question to do.

Spreadsheet Lesson 3: DO copy! It's allowed!

Use the file SpreadsheetLesson3.xlsx

One of the reasons to use a spreadsheet is to save work.

Often you want a spreadsheet to do the same thing over and over; if you did it by hand, you would probably make a mistake, and you would definitely get bored.

You can copy numbers and words in a spreadsheet. You can also copy formulas.

Here's an example. To get a list of positive whole numbers in order, start with 1, then keep adding 1.

	A
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

The first time you add 1, use a formula:

	A
1	1
2	=A1+1

Instead of typing a new formula in A3, click or tap in A2, choose Copy. Move to A3 and choose Paste. The number 3 should appear.

Repeat for the following rows.

But wait! You copied the formula that says $A1+1$. If you paste it into A3, shouldn't it give you 2 again, since A1 is 1, and you have added 1?

Look at the formula in A3:

	A
1	1
2	=A1+1
3	=A2+1

It knew to automatically change the address down 1 cell because you copied it down 1 cell.

Another shortcut: filling

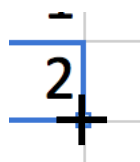
Copying a formula 9 times is too much work. Fortunately, there's a way to do this easily.

Click in the first cell where the formula is, A2.

	A	
1	1	
2	2	+
3		

The cursor is an outlined + sign. Notice the tiny square in the lower right corner of A2.

Move the cursor on top of this square. The cursor changes to a solid + sign.



Now drag down as many cells as you want to fill. The values should fill in automatically. Check that the formulas are correct.

Note: on tablets, the process is a little different.

Use copying and filling formulas to do these problems.

1. Make a list of every third whole number, starting with 1: 1, 4, 7, and so on. Go at least past 100.
2. You are shopping for paper cups for a party. There are a number of choices. Find which is a better buy by computing the unit price for each type of cups.

Number in package	Price of package	Cost per cup
25	\$2.39	
100	4.77	
40	3.29	
10	2.89	
20	5.27	

3. Sam and Gina have a recipe for orange fizzy water they like: 2 cups of orange juice and 5 cups of fizzy water. They want to make a bigger batch.

Sam says that they should add 1 cup of orange juice and 1 cup of fizzy water, and repeat until they have enough..

Gina says they should add 2 cups of orange juice and 5 cups of fizzy water, and repeat.

Make two tables: one for Sam's process, and one for Gina's. Continue for at least 10 more rows.

Will their recipes taste the same? Use your spreadsheet to explain why.

Spreadsheet Lesson 5: Guess and Check Tables

This is a version of an ancient method for solving some kinds of math problems. This method can be done on paper or on a spreadsheet. Sometimes it gives you the exact answer; other times it's faster to use an algebraic method.

Example: Alexander loves cheese, and takes the bus to the cheese store across town. The bus costs \$1.00 each way. Alexander wants to buy Swiss cheese, which costs \$4.00 per pound. Alexander has \$20.00. How many pounds of cheese can he buy?

The idea is to make a table with column headings. The first column should be a guess at what the answer is. The next columns should be computations you need to do to find if your guess is correct. The last column should be a check.

Pounds of cheese	Cost	Cost of bus	Total cost	Is total cost = \$20?
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When you start filling in numbers, use formulas rather than doing the computations mentally (or some other way). The key is that the formulas should be exactly the same in each row.

	A	B	C	D	E
1	Pounds of cheese	Cost	Cost of bus	Total cost	Is total cost = \$20?
2	3	=A2*4.00	=2*1.00	=B2+C2	

If you didn't guess right on the first try, fill or copy your formulas to another row and make another guess.

	A	B	C	D	E
1	Pounds of cheese	Cost	Cost of bus	Total cost	Is total cost = \$20?
2	3	12.00	2.00	14.00	No, too low
3	4	16.00	2.00	18.00	No, too low
4	4.5	18.00	2.00	20.00	Yes!

That was pretty easy. Could you solve it without a spreadsheet? Here's a way to think through it using algebra:

Because all the formulas are the same except for the row number, omit it for a written version.

The number of pounds of cheese is A.

The cost of that amount of Gorgonzola cheese is $A \times 4.00$.

The cost of a round trip on a bus is 2×1.00 , which is easier to write as 2.

The total cost of cheese and bus is $A \times 5 + 2$.

This total should come out to the amount of money Alexander has, \$20.00, which gives an equation $A \times 5 + 2 = 20$. So the problem now is to solve this equation.

Working backwards is a good idea. First subtract the money it will take for the bus, to make sure he doesn't spend his bus fare on cheese:

$$A \times 4 + 2 = 20$$

$$-2 = -2$$

$$A \times 4 = 18$$

So he has \$18 to spend on cheese.

Every \$4 will buy one pound of cheese, so the question is: How many 4's are in 18? Or another way to ask is that the equation asks: What number times 4 is 18? In either case, divide. The answer is $A = 18 / 4 = 4.5$. He can buy 4.5 pounds of cheese.

Actually, things are more complicated:

1. The bus costs \$1.25 each way. Alexander wants to buy Gorgonzola cheese, which costs \$7.39 per pound. Alexander has \$21.53. How many pounds of cheese can he buy?

Make a spreadsheet with a guess and check table for this problem. Use your estimating skills to get a reasonable first guess, but don't spend a lot of time getting a really good guess. The method will do that for you.

If you have not found an answer that gives \$21.53 to the nearest penny after 10 guesses, move on to writing an equation.

Check to make sure he has enough money by multiplying.

Use guess and check tables for these problems, then solve them by writing and solving equations.

2. Sandro's family bought a big screen TV. There was a 5% sales tax. Sandro noticed that the tax amounted to exactly \$35. What was the price of the TV, without including the tax?

3. Mindy's family bought an inflatable kayak for paddling in the lake. There was a 7% sales tax. The tax on the boat came to \$23.48. What was the price of the boat, without including the tax?

Spreadsheet Lesson 6: Guess My Rule, Again

Part I

Your teacher has a spreadsheet set up with an input-output rule.

Ask for the outputs for various input numbers.

Then figure out what rule the spreadsheet is using.

Did different students guess different rules? Can more than one answer be right?

Part II

Make up your own rule and play the game with your group.

Teacher:

Use the file `GuessMyRule.xlsx`, or make your own.

Enter students' input numbers in column A. Output values for your rule will appear in column B.

Encourage them to try numbers that aren't positive integers.

Make sure you do not click in column B, or the formula will show on the screen.

After you have entered a bunch of input numbers, let students try various rules, on their own, or in groups. Do not tell them whether they have guessed your rule.

After a bit of time, ask for suggestions on what the rule is. Ask: If I refuse to show you the formula, how could you argue that your rule is correct?

Try to get several equivalent rules. Type a formula for each in a new column and fill down. For example, if Dani says "multiply by 3, then subtract 7", the spreadsheet should look like this:

	A	B	C
1	Input	Output	Dani's rule
2	5	8	=3*A2-7

Ask students to tell you what to type. Formulas that may be suggested are "multiply the input by 2, then subtract 2" and "subtract 1 from the input, then multiply by 2. Are these really different rules? Have students discuss.

You may want to let this idea hang for a few days without resolving it. A full answer relies on properties; in this case, the distributive property ensures that $2(x-1) = 2x-2$ for all possible values for x .